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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/935,639	08/24/2001	Takashi Nakamura	040894-5699	1378

9629 7590 06/04/2003

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EXAMINER

RAO, SHRINIVAS H

ART UNIT	PAPER NUMBER
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2814

DATE MAILED: 06/04/2003

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

09/935,639

Applicant(s)

NAKAMURA ET AL.

Examiner

Steven H. Rao

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— The MAILING DATE of this communication appears on the cover sheet with the correspondence address —

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☐ Responsive to communication(s) filed on 19 March 2003.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-33 is/are pending in the application.
- 4a) Of the above claim(s) 17-30 is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☐ Claim(s) 1-16, 32-33 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
- Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- 11) ☐ The proposed drawing correction filed on _____ is: a) ☐ approved b) ☐ disapproved by the Examiner.
- If approved, corrected drawings are required in reply to this Office action.
- 12) ☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

- 13) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.
- 14) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).
- a) ☐ The translation of the foreign language provisional application has been received.
- 15) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

- 1) ☐ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) _____
- 4) ☐ Interview Summary (PTO-413) Paper No(s). _____
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other: _____

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R sponds to Amendment

Applicants' amendment filed on March 19, 2003 has been entered on March 26, 2003.

Therefore claims 1,7,8,13,15 and 32 as amended by the amendment and claims 2-6,9-12,14 16 and 33 as previously recited are currently pending in the application.

Claim Rejections - 35 USC § 102

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

Claims 1,3, 7,8, 15 –16 and 31 are rejected under 35 U.S.C. 102(b) as being anticipated by AAPR . (Applicants' Admitted .Prior Art at least shown in figures 17, 18 , herein after AAPR).

Claim 1 is rejected under 35 U.S.C. 102(b) as being anticipated by AAPR (Applicants' Admitted .Prior Art at least shown in figures 17, 18)

With respect to claim1, AAPR describes a semiconductor device having an electrode formed on a surface of a semiconductor substrate, (AAPR fig. 17 # 5,7 formed on substrate 1) wherein said electrode includes a barrier layer consisting of amorphous or micro crystal expressed by an expression of $M1_x M2_{1-x}$ ($0 < x < 1$), (AAPR fig. 17 # 5, 7).

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where M1 is selected from a group consisting of Au, Pt, Ir, Pd, Os, Re, Rh, Ru, Cu, Co, Fe, Ni, V and Cr (AAPR specification page 1 line 20) and M2 is selected from a group consisting of Ta, Ti, Zr, Hf, W, Y, Mo and Nb. (AAPR specification page 1 line 21).

With respect to claim 3, wherein the surface of semiconductor substrate is a tungsten plug formed on the semiconductor substrate (AAPR fig. 17 # 3).

With respect to claim 7, wherein the dielectric layer is PZT. (AAPR specification page 1. line 21).

With respect to claim 8, wherein a lower electrode formed on a semiconductor substrate (AAPR fig. 17), a dielectric layer formed on the lower electrode and constructed by Ferro electric or dielectric having high dielectric constant (AAPR # 2) and an upper electrode formed on said dielectric layer (AAPR fig. 17 # 7) wherein said electrode includes a barrier layer consisting of amorphous or micro crystal expressed by an expression of M1 M2 (AAPR specification page 1).

where M1 is selected from a group consisting of Au, Pt, Ir, Pd, Os, Re, Rh, Ru, Cu, Co, Fe, Ni, V and Cr (AAPR specification page 1 line 20) and M2 is selected from a group consisting of Ta, Ti, Zr, Hf, W, Y, Mo and Nb. (AAPR specification page 1 line 22).

With respect to claim 15, wherein Hayashi describes a semiconductor device having an electrode formed on a surface of a semiconductor substrate, (AAPR fig. 17) wherein said electrode includes amorphous or micro

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crystal single layer expressed by an expression of $M1_x M2_{1-x}$ ($0 < x < 1$), (AAPR specification page 1).

where M1 is selected from a group consisting of Au, Pt, IR, Pd, OS, Re, Rh, Ti, Cu, Co, Fe, Ni, V and Cr (AAPR specification page 1) and M2 is selected from a group consisting of Ta, Ti, Zr, Hf, W, Y, Mo and Nb. (AAPR specification page 1 lines 20-22).

With respect to claim 16, wherein the barrier layer includes of constructive element of substrate material. (AAPR specification page 1 line 19).

With respect to claim 31, wherein a lower electrode formed on a semiconductor substrate (, AAPR fig. 17), wherein said electrode includes at least an element chosen from a first group of Au, Pt, IR, Pd, OS, Re, Rh, Ti, Cu, Co, Fe, Ni, V and Cr (AAPR specification page 1) and at least an element chosen from a second group of Ta, Ti, Zr, Hf, W, Y, Mo and Nb. (AAPR specification page 1).

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

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Claims 2, 4 –6, and 13 are rejected under 35 U.S.C. 103(a) as being unpatentable over (Applicants' Admitted .Prior Art at least shown in figures 17, 18 , herein after AAPR) as applied to claims 1,7,8, 15-16 above and further in view of Hayashi ((Hayashi et al. (U.S. Patent No. 6,133,092 herein after Hayashi).

With respect to claim 2, AAPR does not specifically describe the composition ratio of said barrier layer is directed so that grain boundary becomes amorphous to an extend such that at least any one of diffusion of oxygen and spike can be prevented.

However Hayashi in col. 12 lines 15-22 describes the composition ratio of said barrier layer is directed so that grain boundary becomes amorphous to an extend such that at least any one of diffusion of oxygen and spike can be prevented to prevent atomic migration which may cause changes in contact resistance and other properties and make it difficult to form layered super lattice material.

Therefore it would have been obvious to one of ordinary skill in the art at the time of the invention to include Hayashi's describes the composition ratio of said barrier layer is directed so that grain boundary becomes amorphous to an extend such that at least any one of diffusion of oxygen and spike can be prevented in AAPR"S device to prevent atomic migration which may cause changes in contact resistance and other properties and make it difficult to form layered super lattice material. (Hayashi col. 1 lines 38-43).

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With respect to claim 4, wherein the surface of semiconductor substrate is formed by material which promotes oxidation at crystallization temperature of a dielectric layer to be formed on said surface of semiconductor. (Hayashi Si – substrate and dielectric SiO_2).

With respect to claim 5, wherein the surface of the semiconductor substrate is formed by at least one kind of polysilicon, tungsten, cobalt, molybdenum, copper, silicide of these and alloy of these (Hayashi col. 3 line 40).

With respect to claim 6, wherein a dielectric layer is formed on said surface of electrode. (Hayashi col.3 line 42) .

With respect to claim 13, wherein a lower electrode formed on a semiconductor substrate (Hayashi fig.4 #73, col. 5 line 64), a dielectric layer formed on the lower electrode and constructed by ferro electric or dielectric having high dielectric constant (fig. 4 # dielectric surrounding 73,) and an upper electrode formed on said dielectric layer (AAPR fig. 17 and Hayashi fig. 4 # 60 formed on substrate 51, col. 5 lines 65-67) wherein said electrode includes between said dielectric layer and said upper electrode a barrier layer consisting of amorphous or micro crystal expressed by an expression of $\text{M1}_x\text{M2}_{1-x}$ ($0 < x < 1$), (AAPR specification page 1 and Hayashi fig. 4 # 56, col. 5 lines 66, and lines 30-47). where M1 is selected from a group consisting of Au, Pt, Ir, Pd, Os, Re, Rh, Ru, Cu, Co, Fe, Ni, V and Cr (AAPR specification page 1) and M2 is selected from a group consisting of Ta, Ti, Zr, Hf, W, Y, Mo and Nb. (AAPR specification page 1). wherein said electrode includes a barrier layer consisting of

amorphous or micro crystal expressed by an expression of M1 M2 (AAPR specification page 1 and Hayashi fig. 4 # 56, col. 5 lines 66, and lines 30-47).

B. Claims 9-12, 14 and 32 are rejected under 35 U.S.C. 103(a) as being unpatentable over AAPR (Applicants' Admitted .Prior Art at least shown in figures 17, 18 , herein after AAPR). And Hayashi (Hayashi et al. (U.S. Patent No. 6,133,092 herein after Hayashi) as applied to claims 2-6 ,etc. above and further in view of Xing (U.S. patent No. 6,492,222 Herein after Xing).

With respect to claim 9, wherein the barrier layer consists of iridium tantalum layer $\text{Ir}_x\text{Ta}_{1-x}$ ($0 < x < 1$).

AAPR and Hayashi Hayashi does not specifically teach or disclose the barrier layer as consisting of Ir_xTa .

However Xing, a patent from the same filed of endeavor, describes in col. 9 lines 10 a barrier layer of $\text{Ir}_x\text{Ta}_{1-x}$ ($0 < x < 1$) to form a layer of noble metal that is stable in oxygen and further to minimize degradation against fatigue.

Therefore it would have been obvious to one of ordinary skill in the art at the time of the invention to use Xing's $\text{Ir}_x\text{Ta}_{1-x}$ instead of the other materials taught by Hayashi in Hayashi's device .The motivation to make above mentioned substitution is to form a layer of noble metal that is stable in oxygen and further to minimize degradation against fatigue. (Xing col. 9 lines 7, and col. 610 lines 15-17).

With respect to claim 10, wherein the barrier layer includes a grading layer in which a composition ratio is changed. (Hayashi fig. 5, col. 6 lines 50-55).

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With respect to claim 11, wherein the barrier layer consists of iridium tantalum layer $\text{Ir}_x\text{Ta}_{1-x}$ ($0 < x < 1$). (Hayashi col. 3 lines 50-56- grading layer, Xing col.9 line 10) and the material of the electrode is iridium (Xing col. 9 line 10) .

With respect to claim 12, wherein the barrier layer consists of iridium tantalum layer $\text{Ir}_x\text{Ta}_{1-x}$ ($0 < x < 1$). (Hayashi col. 3 lines 50-56, Xing col.9 line 10) and the material of the electrode is platinum. (Xing col. 9 line 9) .

With respect to claim 14, wherein the barrier layer consists of iridium tantalum layer $\text{Ir}_x\text{Ta}_{1-x}$ ($0 < x < 1$). (Hayashi col. 3 lines 50-56, Xing col.9 line 10) .

With respect to claim 32, wherein the barrier layer is made of IrTaPt. (Xing col.9 lines 9-11).

Any inquiry concerning this communication or earlier communication from the examiner should be directed to Steven H. Rao whose telephone number is (703) 306-5945. The examiner can normally be reached on Monday- Friday from approximately 7:00 a.m. to 5:30 p.m.

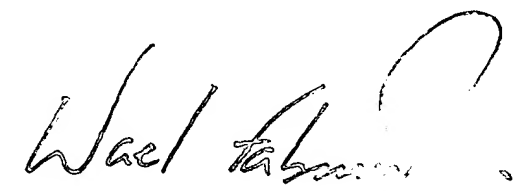
Any inquiry of a general nature or relating to the status of this application should be directed to the Group receptionist whose telephone number is (703) 308-0956. The Group facsimile number is (703) 308-7724.



Steven H. Rao

Patent Examiner

May 31, 2003.


SUPERVISORY PRIMARY EXAMINER